

General Disclaimer

One or more of the Following Statements may affect this Document

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

07
"Made available under NASA sponsorship
in the interest of early and wide dis-
semination of Earth Resources Survey
program information and without liability
for any use made thereof."

II
7.8-1021.0

CTR-157583

Applications of HCMM Satellite Data
to the Study of Urban Heating Patterns

Toby N. Carlson
Dept. of Meteorology
The Pennsylvania State University
University Park, PA 16802

(E78-10210) APPLICATIONS OF HCMM SATELLITE
DATA TO THE STUDY OF URBAN HEATING PATTERNS
Quarterly Report, 1 Jun. - 31 Aug. 1978
(Pennsylvania State Univ.) 7 p
HC A02/MF A01

N78-32515

Unclas
00210

CSCI 13B G3/43

September 1, 1978

Third Quarterly Report - June - August, 1978

HCMM-001

Prepared for:

Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771



RECEIVED

SEP 25 1978

SIS/902.6

1. Report No. 3	2. Government Accession No.	3. Recipient's Catalog No. ---
4. Title and Subtitle Applications of HCMM Satellite Data to the Study of Urban Heating Patterns		5. Report Date 1 September 1978
		6. Performing Organisation Code ---
7. Author(s)	8. Performing Organisation Report No.	
9. Performing Organisation Name and Address Natural Aeronautics and Space Administration Goddard Space Flight Center Greenbelt Road Greenbelt, Maryland 20771		10. Work Unit No. ---
		11. Contract or Grant No. NAS5-24264
12. Sponsoring Agency Name and Address		13. Type of Report and Period Covered 3rd quarterly report 1 June - 31 Aug. 1978
		14. Sponsoring Agency Code ---
15. Supplementary Notes ---		
16. Abstract Research in this quarter has been directed toward model improvement and software development for data handling. Model improvement consisted of formulating a more reliable surface heat flux/temperature scheme, particularly the night time component. Software development has involved writing programs to process U-2 and HCMM data tapes for joining these products to the TOBYGRAF data processing system and for display in BAT files as color images on RAMTEK.		
17. Key Words (Selected by Author(s)) model improvement software development color mapping of images		18. Distribution Statement ---
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages ---
		22. Price* ---

*For sale by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

Technical Report Standard Title Page

ORIGINAL PAGE IS
OF POOR QUALITY

Introduction

Research continues to be directed toward the application of HCMM satellite infrared measurements to the analysis of urban temperature patterns with a goal being to derive the surface energy budget using a surface temperature/heat flux model in conjunction with ground temperature measurements. Generally, the past three months has seen a period of development in which the surface heat flux model has been greatly improved, particularly for the night time case, and applied in some test cases using real ground (or near ground) temperature measurements as input in the model inversion scheme. Computer routines have been written to handle U-2 and HCMM satellite information so that these data can be meshed with our data analysis system (called TOBYGRAF) which we have been developing for over two years. We have also succeeded in utilizing the RAMTEK¹ color density display module in our analyses by accessing directly BAT files of image data.

We have received one series of passes made by a U-2 aircraft flying over St. Louis during May, 1976 and are presently involved in analyzing ground temperature measurements obtained by that aircraft.

Currently, we are ready to begin systematic processing of HCMM data, although we anticipate a brief period for debugging of one untested computer program designed to access the HCMM computer compatible satellite tapes.

Current Research

Our satellite research can be divided into two general categories:

¹Belonging to the Office of Remote Sensing of Earth Resources (ORSER) at Penn State.

model improvement and software development for remotely-sensed data. Both of these approaches are integral parts of our original objective - to use ground temperature measurements obtained remotely to quantify the ground characteristics (notably soil moisture and conductivity) and ultimately to predict the surface heat budget (Carlson and Bolland, 1978).

A significant improvement was made in our 1-dimensional surface temperature/heat flux model, particularly the night time component. Using the improved version of the model we are able to obtain, by graphical inversion of the model, reasonable estimates of the ground conductivity and moisture availability, using, as input, some aircraft measurements of ground temperature made by Dabberdt and Davis (1974) at one location over St. Louis.

A necessary set of conditions for inverting the model to yield these two parameters is the ground temperature at two times on the 24-hr cycle of ground temperature, preferably near noon and during the early morning hours. HCMM will be the first polar orbiting satellite capable of providing infrared ground temperature measurements at these two critical times, approximately 12 hours apart.

We have, as yet, not received any HCMM computer tapes, but we have been able to obtain some peripheral aircraft measurements in the form of U-2 data. One U-2 flight, which we received early this summer, consisted of three aircraft passes made over St. Louis on 25 May 1976. Subsequently, we have written a modified version of our original NOAA satellite extractor routine (RECSTRA 3) which is able to access the U-2 tapes and write segments of each file to a storage tape, thereby joining with the system (TOBYGRAF) which further writes smaller files on to BAT storage and ultimately (as

described in the first quarterly report) to graphics. Acquisition of the U-2 data has been helpful in exercising the use of the TOBYGRAF system, for giving the principal investigator and two new graduate students further experience in handling remotely sensed data, as well as in serving as a future check on the reliability of satellite temperature measurements. Additional aircraft flights by U-2 and by the NASA WB 57 have been made in recent weeks or are anticipated for the coming months.

One especially gratifying advance in our satellite data processing and display routine has been in the incorporation of color graphics using the ORSER RAMTEK system. Currently, we are able to display our 130 x 130 BAT file images with up to 16 different colors (although, customarily we find that six or seven is sufficient).

In anticipation of receiving HCMM satellite data tapes we have taken an original program of J. Price and have modified it to conform with the TOBYGRAF System. This routine (RESTRA 4), yet untested, will serve as the extractor routine for the HCMM satellite tapes.

A recent article (July, 1978) bearing on the combined satellite-model analysis procedure has been published in the Journal of Applied Meteorology by the P.I. and a former graduate student (Carlson and Boland, 1978).

Future Program

We anticipate processing large amounts of HCMM satellite data tapes during the coming quarter. Because of the lag between the start of NAS5-24264 and the dissemination of satellite data tapes, we have requested an eight month extension to the termination date of this project.

HCMM data will be sent for our four urban sites (St. Louis, Los Angeles, Washington, D. C., and Houston) plus one additional location over Tennessee (for August 1978 only), the latter being a focal point for a multi-agency field operation involving EPA and Penn State, which is called the sulfate transport and transformation in the environment (STATE) project, the purpose of which is to study plumes emitted from a power plant complex.

References

1. Carlson, T. N. and F. E. Boland, 1978: Analysis of urban-rural canopy using a surface heat flux/temperature model. J. Appl. Met., 17:998-1013.
2. Dabberdt, W. F. and P. A. Davis, 1974: Determination of energetic characteristics of urban rural surfaces in the greater St. Louis area. EPA contract report No. 68-06-1015, SRI, 77 pp.